DowLohnes

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July 3, 2012

VIA ECFS

Marlene H. Dortch, Esq.
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Notification of *Ex Parte* Communication
IB Docket No. 11-109; FCC File No. SAT-MOD-20101118-00239

Dear Ms. Dortch:

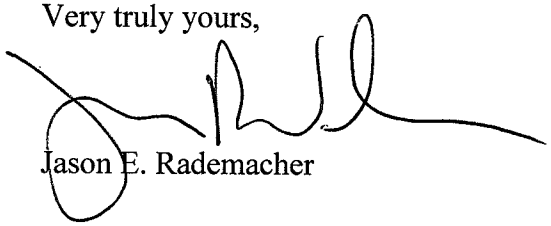
On June 29, 2012, Andrew Etkind, Vice President, General Counsel and Secretary of Garmin Ltd. ("Garmin"), Scott Burgett, Director, GNSS and Software Technology for Garmin, and M. Anne Swanson of Dow Lohnes PLLC (collectively the "Garmin Representatives") held separate meetings regarding the above-captioned proceedings with the following:

- Louis Peraertz, Legal Advisor on Wireless, International, and Public Safety for Commissioner Mignon Clyburn;
- Mindel De La Torre, Chief of the International Bureau, and Gardner Foster, Assistant Chief of the International Bureau; and
- Julius Knapp, Chief of the Office of Engineering and Technology ("OET"), Ronald Repasi, Deputy Chief of OET, Mark Settle, Deputy Chief of the Policy and Rules Division of OET, Robert Weller, Chief of the Technical Analysis Branch of the Electromagnetic Compatibility Division of OET, Michael Ha of OET, and John Chambers, Special Advisor to Chairman Julius Genachowski.

At the meetings, the Garmin representatives encouraged the FCC to proceed quickly to adopt the proposals included in the Public Notice "International Bureau Invites Comment on NTIA Letter Regarding LightSquared Conditional Waiver," issued in IB Docket No. 11-109 on February 15, 2012. Garmin participated actively in the testing described in the Public Notice and noted in the meetings that the evidence produced in the testing conclusively supports the FCC's recommendations in the Public Notice. The Garmin Representatives urged that Commission action on these recommendations should not await review of any other proposals submitted by LightSquared. The attached materials were distributed in the meetings and include additional detail on the information covered in the meetings.

As required by Section 1.1206(b), as modified by the policies applicable to electronic filings, one electronic copy of this letter is being submitted for the above-referenced docket.

Very truly yours,



Jason E. Rademacher

Attachments
cc w/attach. (via email):

John Chambers, Esq.
Louis Peraertz, Esq.
Mindel De La Torre, Esq.
Mr. Julius Knapp
Gardner Foster, Esq.
Mr. Ronald Repasi
Mr. Michael Ha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Garmin Innovation and GPS Overview

Garmin: A History of Innovation

Garmin has a long history of innovation:

- Since its inception in 1989, Garmin has evolved as the leading, worldwide provider of navigation, communication and information devices and applications, most of which are enabled by GPS technology.
- This has been possible due to a known and stable spectrum environment, free from regulatory restrictions and frequent repurposing of the spectrum.
- GPS receivers are designed to suit the needs of specific market segments and are not burdened with extensive regulation and certification requirements (except in the FAA certified aviation receiver market segment).
- Garmin's broad product portfolio meets the needs of a wide variety of customers, and brings critical safety-of-life applications to the global marketplace.

Garmin: Multiple Product Markets

Today, Garmin markets GPS devices in five main areas:

- Aviation
- Marine
- Outdoor
- Fitness
- Portable Navigation – auto/mobile

Aviation Segment

Leader in the General Aviation Market

- **Leading provider of forward fit (OEM), retrofit, and portable aviation equipment to the general and business aviation market**
  - Over 120,000 GNS 430 & 530 products in service
  - Over 3,400 GTN 650 & 750 products in service
  - Over 10,500 G1000 Integrated Flight Decks in service
  - Over 700 authorized sales & service centers worldwide
  - Strong market share in both Aftermarket and OEM
- **Partner with over 15 industry leading aircraft manufacturers**

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Marine Segment

Leading Manufacturer of Marine Electronics

- Broad range of products – GPS chartplotters, sonar, radar, real-time weather, autopilot, networking capabilities, multi-function displays including new touch screen display with intuitive interface
- Revolutionary Bluechart g2 “Vision” cartography – True 3D mapping views, detailed satellite imagery
- Strong market share in marine electronics market of > 25% in a highly fragmented market
- With the federal government’s decommissioning of the LORAN system on February 8, 2010, GPS devices have become the primary means of providing safety on US waterways.

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Outdoor Segment

Leading Manufacturer of Outdoor Products

- Diverse portfolio of products designed for wide range of outdoor activities including: hunting, hiking, geocaching, golfing, tracking and canine training
- Rugged and reliable products used for search and rescue operations as well as by military and law enforcement
- Market leader in outdoor handhelds with >80% market share
- Strong market presence in major retailers and specialty retailers catering to skilled enthusiasts – Best Buy, Wal-Mart, Target, REI, Cabela's, Dick's, Bass Pro Shops

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Fitness Segment

Leading Manufacturer of Fitness Products

- Unique product offerings including running and cycling devices, measurement sensors and web portal to track and share performance data
- Integrated sensor technology to monitor biometrics (e.g., heart rate) to improve users' health and save lives
- Global leader in GPS-enabled fitness with nearly 1.5 million units sold in 2011
- Strong market presence in major retailers and specialty retailers catering to skilled enthusiasts – Best Buy, Wal-Mart, Target, Dick's

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Automotive Segment

Global Leader in Portable Navigation Market

- Full range of product offerings – basic to advanced navigation features
- Stand alone and connected Portable Navigation Devices (PNDs) with live services
- nüvi 3790T offers the thinnest, most elegant PND form factor in the market
- Industry leading features:

Lane Assist & photoReal Junction View	Traffic & real-time traffic camera information
ecoRoute	Gas Prices
Delivery of map and content update services	Local Search
In-vehicle and pedestrian navigation	Movie listings
Superior speech recognition technology	Weather
	Safety cameras

- #1 market share in North America, #2 market share in Europe
  - North America 62%
  - EMEA >30% (including Navigon)
  - Worldwide 38% (including Navigon)
- Highest volume market segment for Garmin

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Garmin Economic Contributions

Garmin makes a significant contribution to both the US and the global economy.

- Nearly16 million units sold worldwide in 2011
- Global leader in each market we serve
- Expected 2012 revenue of $2.7B
- Worldwide employment of over 9,200 associates
- Profitable every year since the Company's inception in 1989
- 97 million GPS enabled units sold worldwide since inception
- Strategic emphasis on market segmentation and vertical integration

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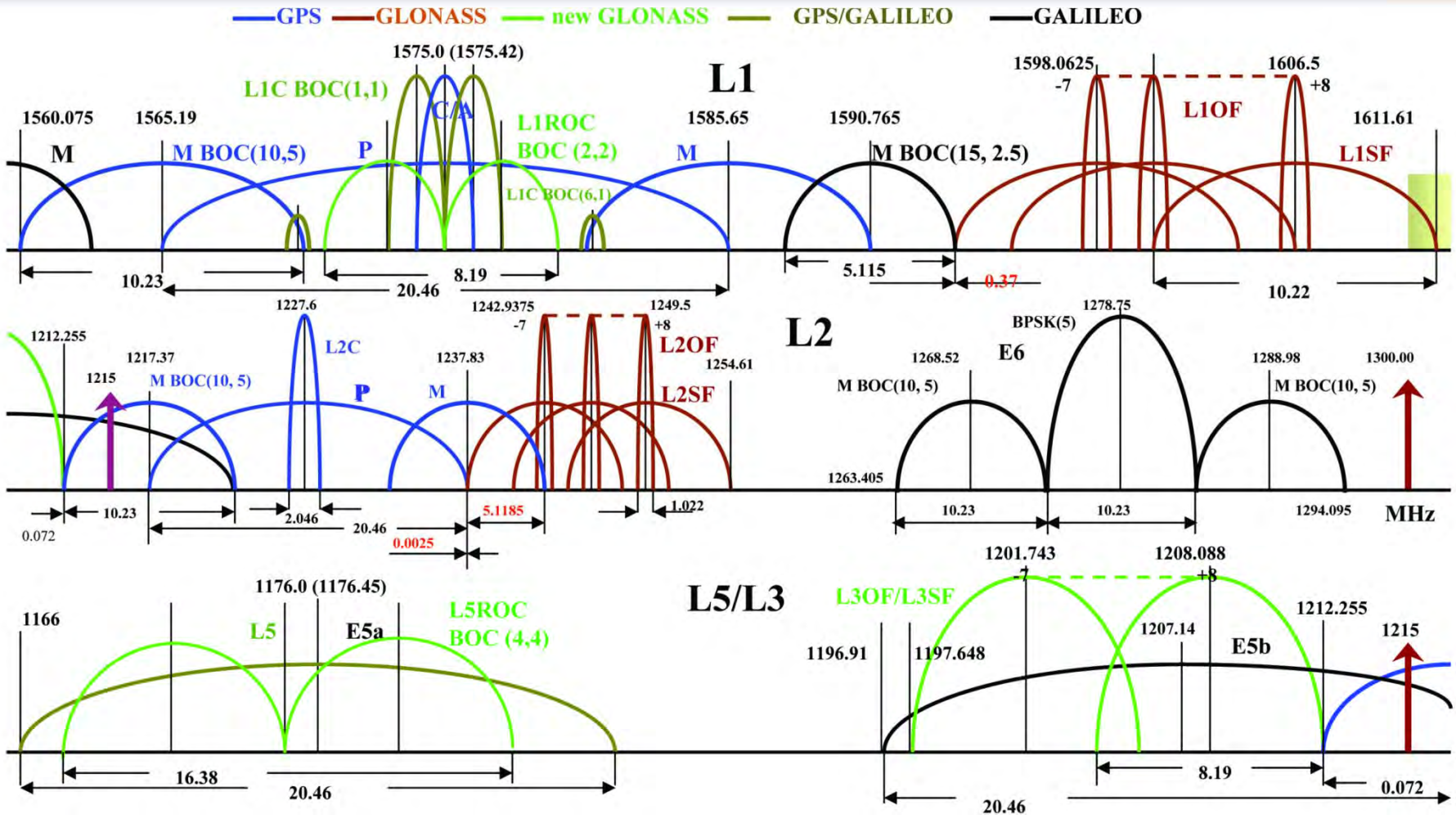
GPS System Overview

The Global Positioning System (GPS) enables determination of precise location using very low power radio signals from distant satellites.

- Satellites are located in Medium Earth Orbit, more than 12,000 miles above the earth.
- Satellites are solar powered, which necessitates low-powered radio transmissions (~50 Watts).
- Receivers must be extremely sensitive in order to receive the low-power GPS signals.
- GPS signal power on the ground is less than a millionth of a billionth of a Watt (1e-15 Watts).

GPS System Overview



The GPS system operates alongside other Global Navigation Satellite Systems (GNSS) in the Radio Navigation Satellite Service (RNSS) band.

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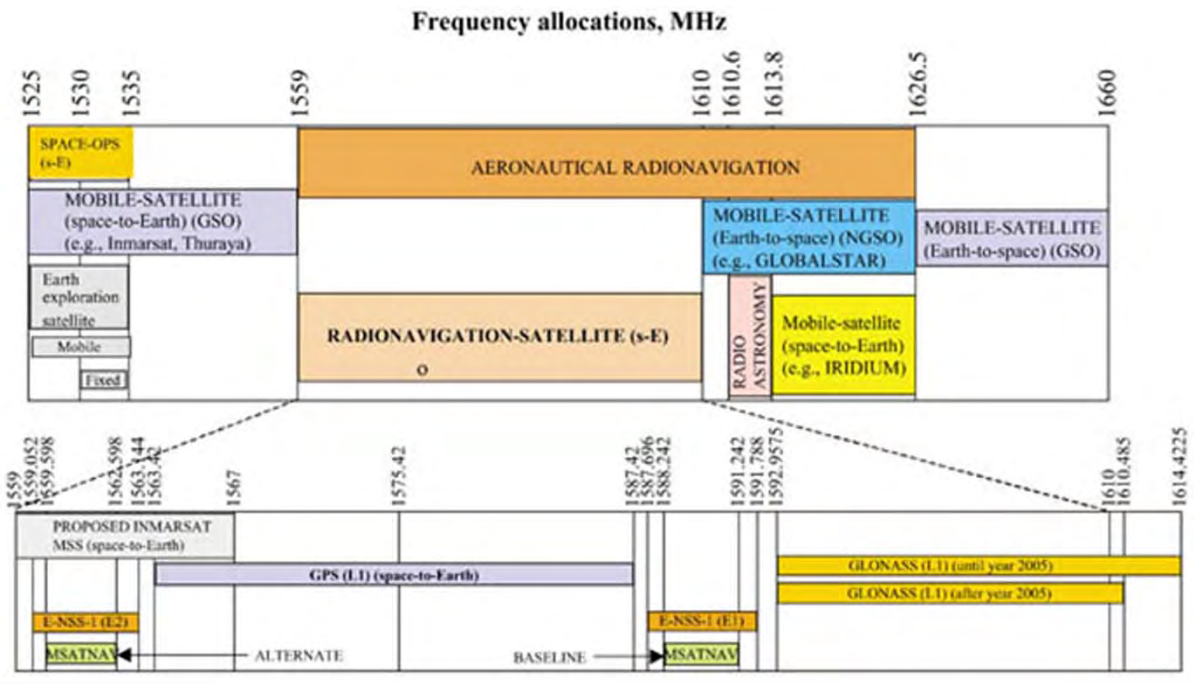
GPS System Overview

GNSS systems operate in the Radio Navigation Satellite Services (RNSS) band. This is not an accident. These frequencies were chosen intentionally because of their excellent propagation characteristics through the earth's atmosphere. Mobile satellite services bookend the GPS spectrum.



The MSS band is a quiet, low-power spectrum neighborhood ideally suited for space-to-earth and earth-to-space transmissions. Any changes to spectrum allocation must be the result of careful study, testing, and consideration of incumbent uses.

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The LightSquared Process

The LightSquared Process

Since LightSquared's first request for a fundamental repurposing of the MSS-band in November 2010, Garmin has been an active participant in the process of testing and evaluating the impact to GPS devices.

- When LightSquared first requested a waiver of the integrated service rule on 11/18/10, Garmin immediately commenced testing of GPS devices with respect to the LightSquared terrestrial signal.
- LightSquared's request would have permitted it to offer terrestrial service without regard to whether that service would interfere with LightSquared's own or other satellite services operating on the same or adjacent spectrum.
- In a letter to NTIA on 12/28/10, the Department of Defense raised objections that granting LightSquared's requested authorization would severely disrupt operations of both government and non-government GPS devices.
- Garmin's test results, showing the catastrophic implications of high-powered terrestrial signals in the MSS band, were filed with the FCC on 1/20/11.

The LightSquared Process

- On 1/26/11, the FCC granted LightSquared's requested waiver with conditions requiring LightSquared to work with the federal government and the GPS industry to test the interference through a technical working group ("TWG") process and stating that LightSquared could not commence operation until it had demonstrated mitigation of the interference.
- Garmin was a key participant in the TWG process and chaired the General Location/Navigation subteam.
- Garmin actively supported the RTCA's testing and analysis of the impact on aviation.
- Garmin participated in subsequent NTIA-sponsored testing at White Sands Missile Range (WSMR) in fall 2011, contributing both test devices and manpower.
- **On 2/14/12, NTIA submitted a letter to the FCC concluding that LightSquared's proposed operations could not coexist with GPS without causing interference and transmitting, as support, studies from the National Executive Committee for Space-Based Positioning, Navigation and Timing and the FAA.**
- **On February 2/15/12, the FCC issued a public notice seeking public comment on rescinding LightSquared's conditional waiver and suspending indefinitely its authority to offer terrestrial services.**

Brief Overview of Recent Test Reports

The report of the most recent testing conducted by the National Executive Committee for Space-Based Positioning, Navigation & Timing (PNT) was publically released on 2/14/2012.

This report provides the results of testing conducted last fall at White Sands Missile Range and at the Space and Naval Warfare Systems Command. The tests evaluated the performance of GPS devices in the presence of LightSquared's modified transmissions in its lower 10 MHz band. Among the key findings were the following:

1. 75% of the units tested would suffer harmful interference from the LightSquared signal
2. The report concludes that there are no proven mitigation options at this time, and, if any were to materialize, they would take years to implement.
3. LightSquared handset transmissions have the potential to cause interference to GLN devices.

http://www.gps.gov/news/2012/02/lightsquared/NPEF-report.pdf

Brief Overview of Recent Test Reports

FAA Report on LightSquared Interference to Certified Aviation Devices released on 1/27/2012

Since the summer of 2011, the FAA has worked with LightSquared (at a cost to taxpayers of more than two million dollars) to understand the effects of 40,000 LightSquared transmitters on certified aviation GPS receivers. The FAA's report draws two critical conclusions:

1. The LightSquared network is not compatible with FAA requirements for GPS receivers used in low altitude aviation operations. (Perhaps most concerning is interference to terrain awareness and warning systems (TAWS) which help keep planes and helicopters from flying into the ground.)
2. Due to the wide variety of environments where certified aviation GPS receivers must operate, the FAA determined that there is no readily-available mitigation option for the LightSquared interference.

http://www.gps.gov/news/2012/02/lightsquared/FAA-report.pdf

FCC Request for Public Comment

Two proposals from the FCC on which its 2/15/2012 public notice requested comments:

1. Vacatur of the *Conditional Waiver Order* due to LightSquared's inability to address satisfactorily the legitimate interference concerns surrounding its planned terrestrial operations, and the conclusion that the interference resolution process has no realistic prospect of being successfully completed by LightSquared in a reasonable period of time.

2. Modification of LightSquared's satellite license, pursuant to Section 316 of the Communications Act, to suspend indefinitely LightSquared's underlying ATC authorization, first granted in 2004, to an extent consistent with the *NTIA Letter.*

A dozen entities filed comments on 3/16/2012; reply comments were filed on 3/30/2012.

Garmin Receiver Specification and Design

GPS Receiver Specification

- **Garmin works closely with third party GPS chipset suppliers**
  - Weekly or bi-weekly phone calls to discuss technical issues and drive supplier roadmap
- **Specifications primarily market driven: what are the best price and performance possible to enable a wide variety of consumer products**
- **Other characteristics that must be considered in chipset specification:**
  - Physical size of the chipset
  - Power consumption
  - Sensitivity
  - Interference / jammer rejection
  - Integration with complementary wireless technology (Bluetooth, WiFi, FM)
  - Multi-constellation
  - Integration with application processors

GPS Receiver Specification

- **Garmin works closely with component vendors to specify Low Noise Amplifiers (LNAs) and filters that meet the needs of each market segment.**
- **Specifications primarily driven by market segment: what performance is required to enable best-in-class consumer and aviation products**
- **Important characteristics of front end components:**
  - Physical size of LNA and filters
  - Power consumption
  - Gain / noise figure
  - Linearity / compression
  - Adequate bandwidth for multi-constellation support while also rejecting interference within the known spectrum environment (e.g., cellular bands, Bluetooth/WiFi)
  - Phase / group delay across passband

GPS Receiver Specification

- **The rate of innovation is very rapid in the consumer space**
- **A supplier typically delivers new chipsets every 12 to 18 months**
- **Some factors driving innovation:**
  - Complementary Metal-Oxide-Semiconductor (“CMOS”) process improvements: 90 nm -> 65 nm -> 45 nm. This reduces power and cost. Garmin is constantly moving to parts with lower CMOS feature size.
  - Integration of RF into CMOS -> full CMOS radios rather than bi-CMOS. This reduces cost.
  - Multi-GNSS: GPS + Glonass + Galileo + Compass + QZSS + ?
  - Modernized GPS Signals → L1C
  - Integration of GPS with other wireless technologies
  - Integration of GPS with application processors to create special purpose System on Chip (SoC) parts
  - Receiver performance improvements (better sensitivity, more correlators possible w/ shrinking die sizes, etc.)

GPS Has Unique Characteristics

- **GPS is a radio navigation system and differs from radio communications systems**
- **The primary measurement in GPS is the timing of bit transitions in the navigation signal**
  - Precise positioning requires sub-ns measurements of bit edge
  - Accurate measurement of bit edges requires wide receiver bandwidth
  - Effective multipath rejection also requires wideband signals
- **Spread spectrum GPS signals are below the thermal noise floor when received**
  - Cumulative effects of in-band interference can increase noise floor and degrade performance

The Product is Everything

- **Success or failure in the consumer marketplace is driven primarily by customer acceptance of the product.**
- **Garmin's success is evidenced by the fact that many customers, particularly in the aviation GPS sector, continue to use the products for a decade or more.**
- **Products that don't work well simply don't sell.**
- **Examples of poor performance of GPS:**
  - Poor first fix performance
  - Poor accuracy
  - Poor urban canyon performance
  - Poor dynamic performance
  - Poor battery life
- **Poor performance in any of these areas is addressed directly with the chipset supplier.**
- **Selection of chipsets in future designs is contingent upon satisfactory performance for the customer.**

Certified Aviation Perspective

- **FAA standards are the primary source of performance requirements for certified aviation products.**
- **Given safety concerns, detailed design requirements are appropriate.**
- **FAA standards for GPS receivers include detailed design requirements for:**
  - Receiver sensitivity and dynamic range
  - Ranging and positioning accuracy
  - Differential group delay
  - Receiver bandwidth
  - Interference rejection
  - Correlator spacing (extremely design specific)
  - Environmental conditions (temperature, vibration, lightning, RF susceptibility)
  - Compatibility with other aircraft systems
- **Garmin also designs/manufactures other aviation radio systems**
  - VHF communications & navigation radios, satellite data link, transponders, weather radar
  - Mix of licensed and unlicensed products
  - There are distinct FAA design standards for each of these products

FAA GPS Interference Rejection Requirements

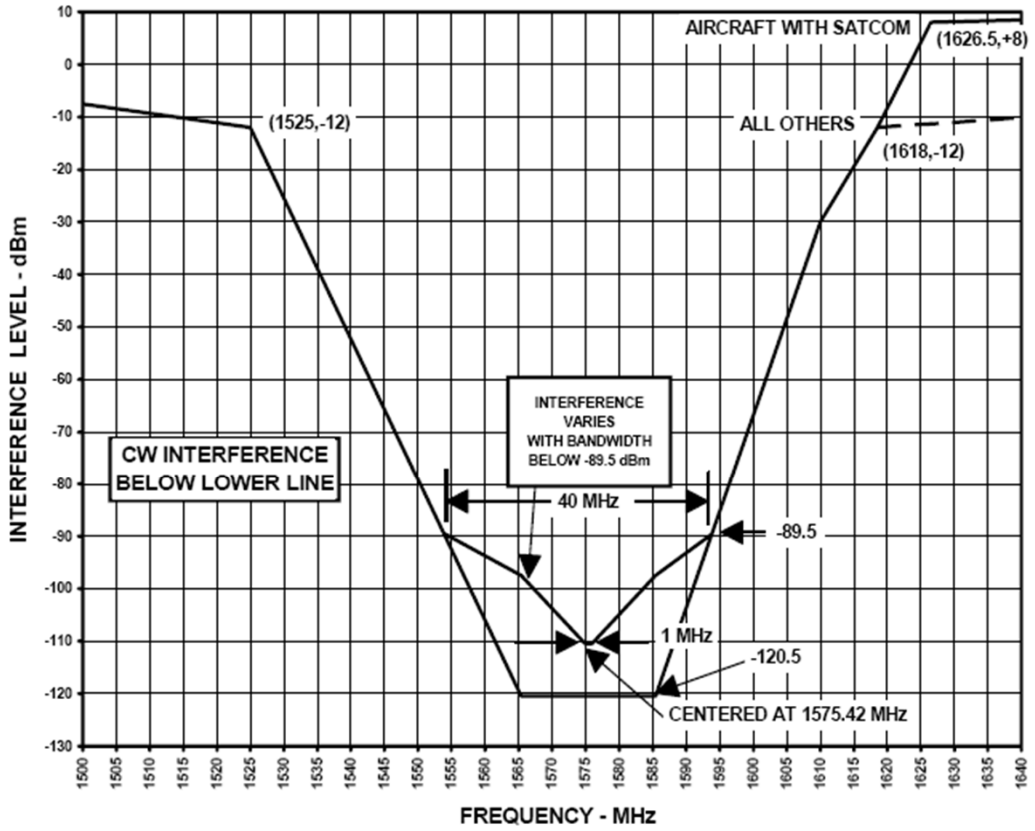

FIGURE C-1 INTERFERENCE LEVELS AT THE ANTENNA PORT

- **All new FAA certified GPS receivers are required to tolerate interference at these levels.**
- **Standard published in 1996 in RTCA/DO-229, adopted internationally in 2001**
- **Equipment certified to this standard first introduced in 2002**

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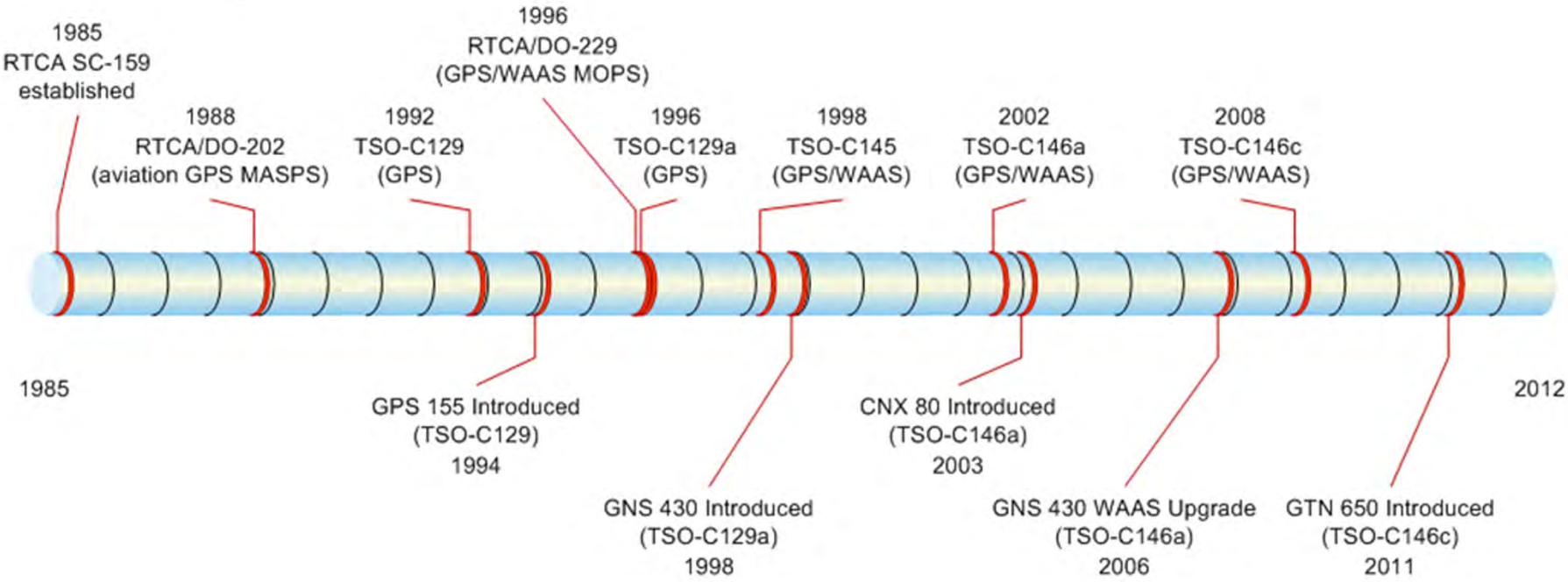
Certification Costs

- **Compliance with these standards requires time and expense**
  - Extensive documentation required throughout product development cycle to show compliance
  - Rigorous performance testing over a wide range of environmental conditions
- **The need for detailed design and verification data complicates the use of third party chipsets commonly used in the consumer space.**
- **Cost of non-compliance is high**
  - Aviation products have safety-of-life implications
  - Cannot ship aviation products that do not meet FAA Technical Standard Orders (TSO)
  - Safety issues require immediate customer notification and in some cases may result in grounded aircraft.
  - Grounded aircraft = no revenue and other significant impacts to business
- **Changes to existing products are similarly expensive**
  - Modifications require recertification
- **Expensive certification process translates into an expectation of a long service life for aviation products – more than 10 years.**

Standards vs. Innovation

- **Pace of innovation in certified aviation is slower than in the consumer marketplace.**
- **Aviation standards are developed by RTCA in consultation with government, industry, and users**



- **Standards updates – 4 years on average**
- **Equipment introductions – 2-5 years within a product line**
- **Typically 10-15 years to develop standards, design and certify products, and equip**
- **Compare to consumer – new products 12-18 months**

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Introduction

Garmin appreciates OET's participation and involvement in the testing and review that led to the FCC's February 15, 2012 recommendations.

- Garmin appreciates the careful process the FCC adopted to address interference concerns with respect to the LightSquared conditional authorization.
- An inclusive process allowed many parties to participate in technical investigations reviewing the interference issues
- As a result, overwhelming evidence of severe interference to GPS was collected and analyzed
- That evidence fully supports the FCC's February 15 recommendations that LightSquared's conditional waiver be vacated and its ATC authority be indefinitely suspended. Garmin hopes the FCC will act promptly to adopt these recommendations.

Garmin supports further development of broadband service and remains committed to working with all interested parties to ensure its expansion while at the same time ensuring that the valuable national asset of GPS is protected.

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Technical Review

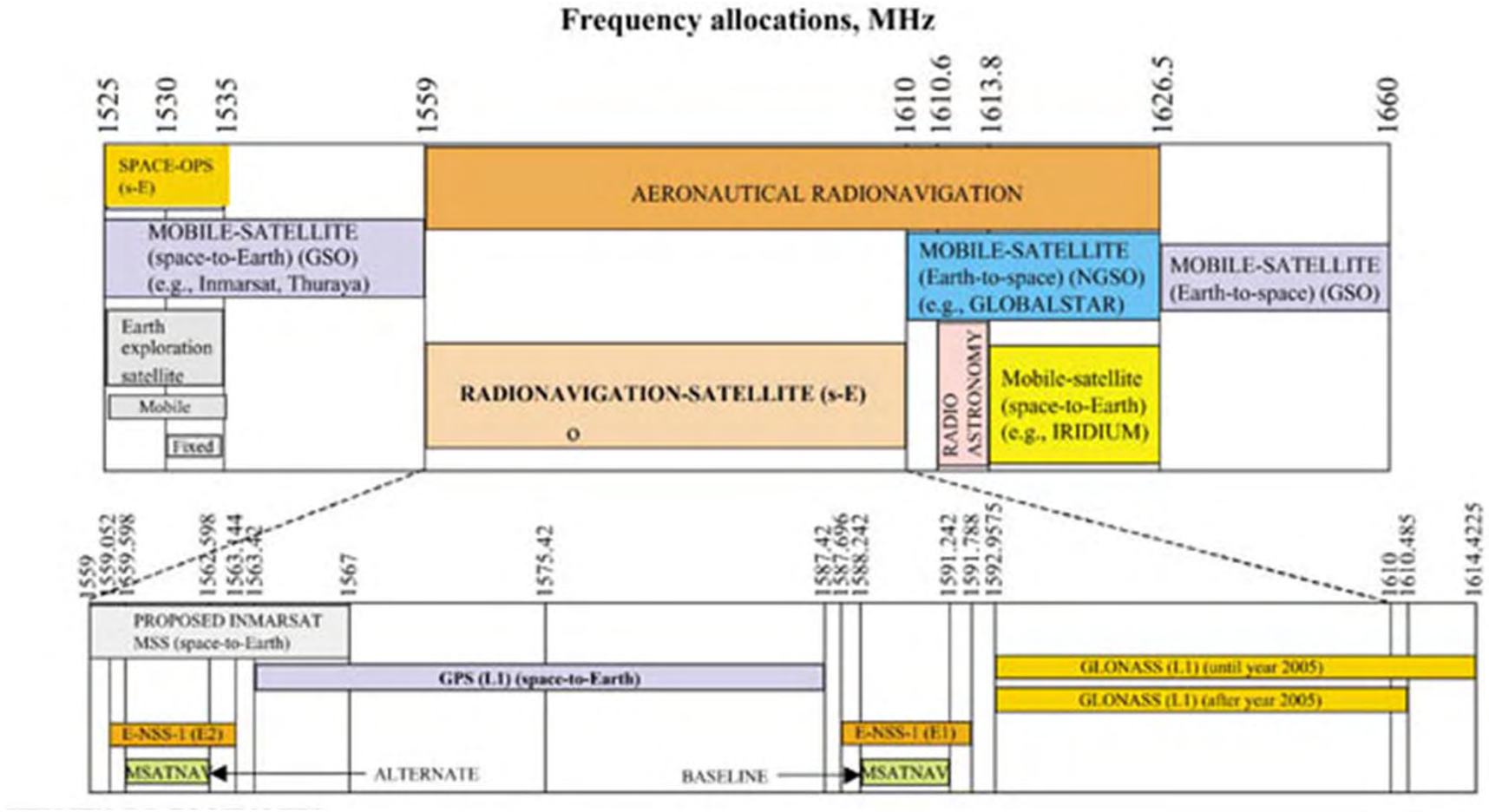
MSS / RNSS Spectrum Overview

The MSS Band and RNSS bands are both designed to accommodate low-power satellite services operating in close proximity to one another.

- System design allows for minimal guard bands in between MSS and RNSS (reference spectrum chart on next slide)
- Both systems must operate at similar power levels to maintain compatibility
- This is an example of efficient spectrum management by aggregating like services in adjacent bands to minimize the need for guard bands and the likelihood of co-channel interference
- This approach is not compatible with placing high-power terrestrial signals in adjacent spectrum

MSS / RNSS Spectrum Overview

GNSS systems operate in the Radio Navigation Satellite Services (RNSS) band. Mobile Satellite Services (MSS) bookend the RNSS spectrum.



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Satellite vs. Terrestrial Communication Systems

There are many differences between low-power satellite systems and high-power terrestrial broadband systems.

- MSS and RNSS systems are designed to accommodate low-power signals received from distant satellites.
- Mobile broadband networks are designed to utilize high-power terrestrial signals broadcast from tens of thousands of towers around the nation.
- If placed in adjacent bands, the high-power terrestrial signals from mobile broadband networks would overwhelm the lower power satellite signals from MSS and RNSS. This overloading would impair the functioning of these systems and should not be permitted.

Navigation Systems vs. Communication Systems

GPS is a navigation system and differs from radio communications systems.

The primary measurement in GPS is the timing of bit transitions in the navigation signal.

- Precise positioning requires sub-ns measurements of bit edges
- Accurate measurement of bit edges requires wide receiver bandwidth
- Effective multipath rejection also requires wideband signals

Spread Spectrum GPS signals are below the thermal noise floor when received.

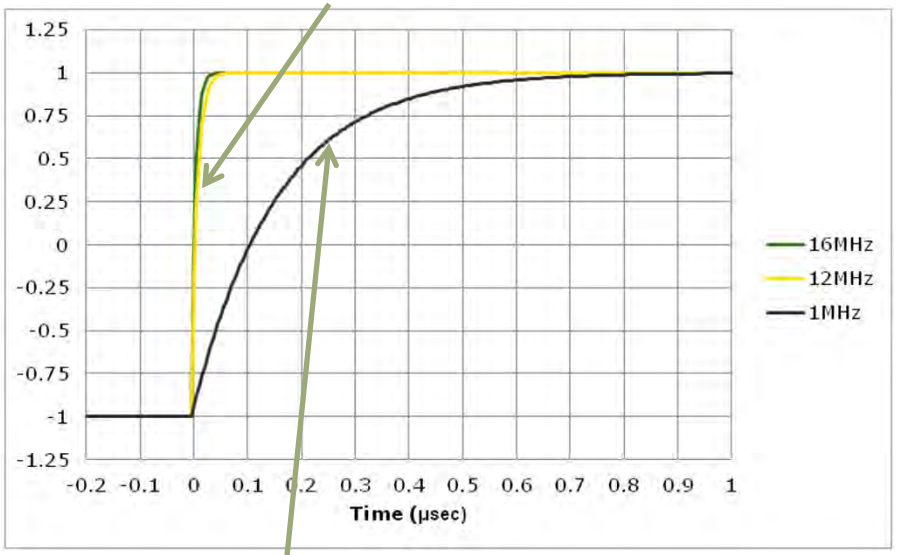
- The cumulative effects of in-band interference can increase the noise floor and degrade performance.

Navigation Systems vs. Communication Systems

GNSS is based on range measurements to the satellites

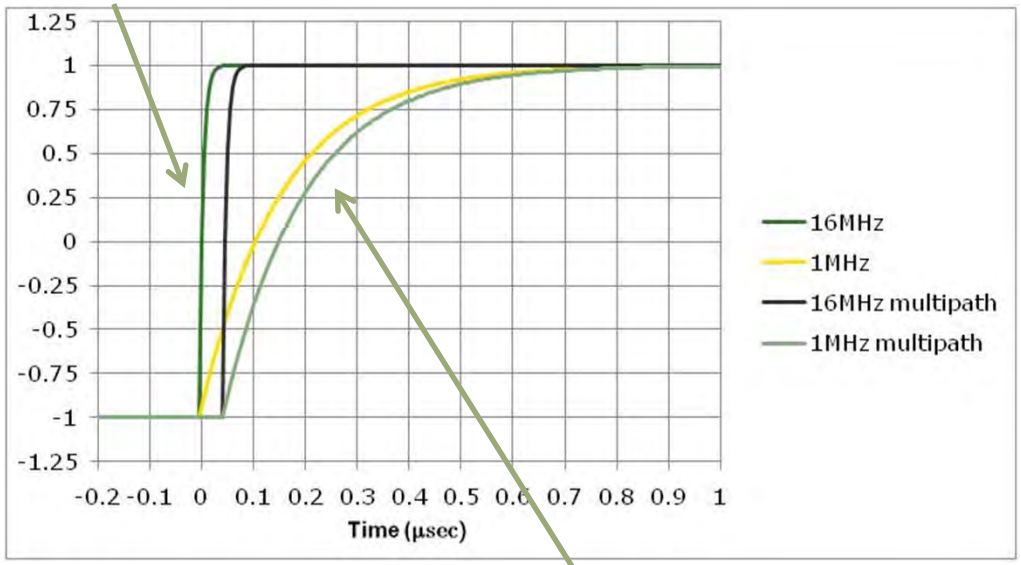
- Measure time of arrival (TOA) of spreading code transitions
- Accuracy of TOA measurement depends on sharp code edges
- Sharpness of code edges depends on bandwidth
- Also need sharp edges for multipath suppression

Code edge is here.



Where is the code edge?

Can distinguish code edge from multipath.



Difficult to distinguish code edge from multipath

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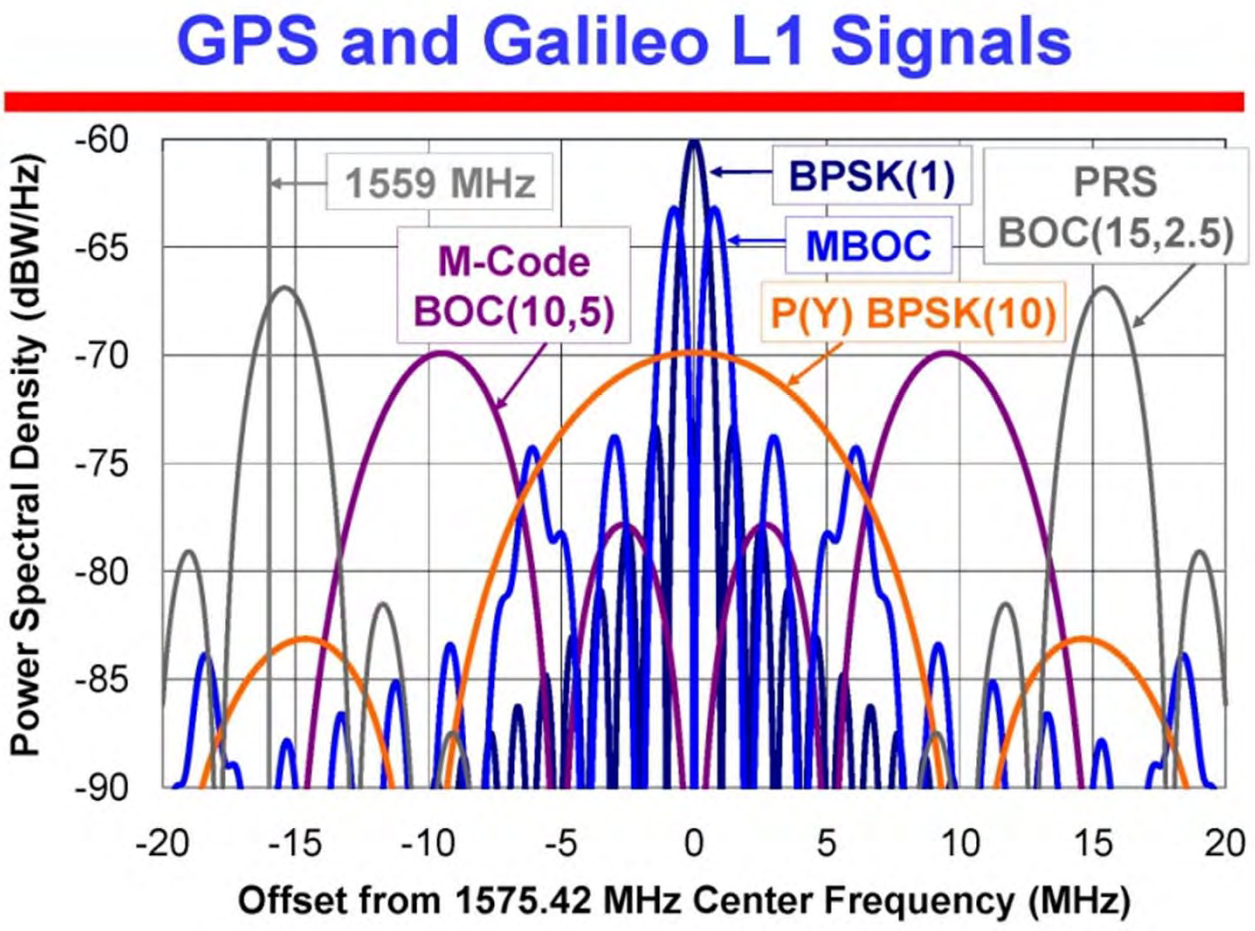
Navigation Systems vs. Communication Systems



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Navigation Systems vs. Communication Systems

Multiple wireless and other systems could cumulatively add noise in GNSS bands until GNSS is degraded

GNSS signals are CDMA spread spectrum with very low-power density

- C/A power density less than -190 dBm/Hz (~20 dB below thermal noise)
- Allows many GNSS signals to occupy the same spectrum without noise floor degradation

De-spreading of the GNSS signals spreads any (even narrow band) interfering signal over the entire bandwidth

- The total power of all in-band interference is spread across the entire bandwidth, potentially increasing the noise floor
- If the total in-band interference power is greater than thermal noise, GNSS performance is degraded

Additional Technical Points

Updates to GPS Technology

The US government will begin to deploy the L1C code with Block III satellite launches beginning in 2014.

- L1C, along with Galileo, GLONASS and other modern GNSS systems, requires wider receiver bandwidth than traditional L1 C/A code receivers.
- This is due to the fact that the L1C signal will be transmitted in a wider bandwidth, thus allowing consumer-grade GPS receivers to offer significantly improved positioning performance.
- These wide bandwidth signals will be even more susceptible to interference if high-power terrestrial transmissions are allowed in adjacent bands

Spectrum Sharing

Users of the RNSS band are good neighbors and spectrum sharing is a common practice.

- Many services share the same spectrum in the L1 band – *e.g.*, GPS, Galileo, soon to be Glonass.
- So many services can share the L1 band because they operate *below* the thermal noise floor
- It is impractical to suppose that a navigation system like GPS could share spectrum with a communication system that broadcasts at vastly higher signal levels that have the effect of raising the noise floor in nearby bands.

Recommendations Going Forward

Recommendations

- **The FCC should act decisively and follow through on its February 15, 2012 recommendations to vacate LightSquared's conditional waiver and indefinitely suspend its ATC authority.**
- **LightSquared's proposal that the FCC locate alternative spectrum for its terrestrial network should not delay action on the February 15 recommendations.**
- **If the FCC wants to consider further the terrestrial use of L-Band frequencies, it should do so through a notice and comment rulemaking process that allows input from affected parties.**


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